

The National Library of Medicine

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WILLIAM H. WELCH, one of the towering figures in American medicine, declared that there were four major medical contributions of the United States in the 19th century: the development of anesthetics, the discovery of insect transmission of disease, the establishment of the modern public health laboratory and the development of the Library of the Surgeon-General's Office (Army) and the *Index-Catalogue* of that collection. Of the four, Welch believed the last was the greatest.¹

The legacy of that accomplishment is an institution in which American physicians today can take justifiable pride: the National Library of Medicine (NLM). The Library (Figure 1), now a part of the National Institutes of Health in Bethesda, Maryland, is the lineal descendant of the Library of the Surgeon-General's Office.

The Billings Era

Although the Library dates its founding from 1836, it was not until John Shaw Billings, an Army surgeon, assumed charge in 1865 that the Library began to be regarded as a medical treasure of the first order. Under Billings' direction, the collection grew from 1,800 volumes (1865) to 117,000 books and 192,000 pamphlets at the time of his retirement in 1895.

Billings' tireless efforts to collect all of the world's growing body of medical literature can be traced to his experience as a medical student. In attempting to write a dissertation he discovered that there was no library in the United States, public or private, where a medical practitioner or

researcher might find a large body of the published literature relating to any medical subject. Thus it was, when the position was offered to him, he eagerly accepted the responsibility of directing the Library of the Surgeon-General's Office.

In 1879 Dr. Billings developed a guide to the world's biomedical journal literature which is today, almost one hundred years later, familiar to medical professionals—*Index Medicus*. Billings' greatest achievement, however, was the publication, beginning in 1880, of the *Index-Catalogue of the Library of the Surgeon-General's Office*. This covered all of the world's published literature, journal and monograph, in the Library's collection, organized by subject and author. It was to take 15 years for the entire 16-volume catalog to be published, through the letter Z. Now, for the first time, any medical student writing a dissertation here or abroad had under firm control the bulk of the literature that he needed.²

To this day, descendants of the two works (the former still under its original title, the *Index-Catalogue* now superseded by the *NLM Current Catalog*) continue to be published by the National Library of Medicine. Whether Billings' comment on all this indexed and cataloged material also continues to be valid is left to the reader: "The proportion of what is both new and true is not much greater in medicine than it is in theology."²

Dr. Billings, in addition to his duties at the Library, was in charge of vital statistics for the Tenth Census (1880). He discussed with Herman Hollerith, a young engineer in the Census Office, the need for a machine to do the purely mechanical work of tabulating the census and population

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NATIONAL LIBRARY OF MEDICINE

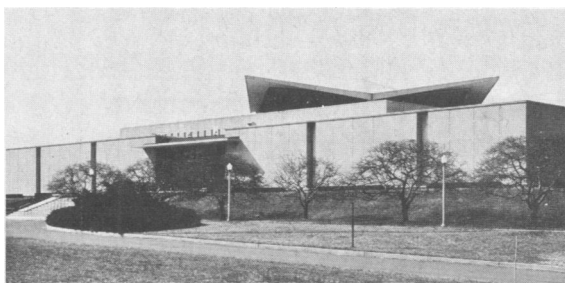


Figure 1.—The National Library of Medicine is on the grounds of the National Institutes of Health in Bethesda, Maryland.

statistics. Billings suggested that statistical data might be recorded on a card by punching small holes in it and that these cards might be counted and sorted mechanically.³

As Hollerith later wrote, "After studying the problem I went back to Dr. Billings and said I thought I could work out a solution for the problem and asked him would he go in with me. The Dr. said no he was not interested any further than to see some solution to the problem worked out."⁴

Hollerith did indeed work out a solution to the problem, and the first electric tabulator he developed, based on the principles Billings suggested, was used with great success in the 1890 census. With his equipment, the classification and counting were done in a third the time of the 1880 census. Hollerith subsequently improved and refined his machine and eventually sold his patents to what is now IBM.

MEDLARS

These two accomplishments—an index to the medical literature and a rudimentary computer—evolved independently down through the years. Then, in the 1960's, they were brought together in a way that even Dr. Billings could not have foreseen. The result of this union was MEDLARS, the computer-based Medical Literature Analysis and Retrieval System, which became operational at the National Library of Medicine in 1964.

MEDLARS is based on the skilled indexing and cataloging of published materials received by NLM. This aspect of the system—extracting pertinent data from the printed page—would be quite familiar to Billings and, in fact, is essentially similar to the abstracting and indexing he accomplished for the *Index-Catalogue* and the original *Index Medicus*. However, with MEDLARS it now became possible to join this intellectual process with a sophisticated electronic computer for the storage and retrieval of medical information.

Using the system, the Library can produce in a matter of hours typeset copy for a 1,000-page bibliography containing more than 20,000 articles indexed each month.

The problem of redundancy and poor quality medical literature, which plagued Billings 100 years ago, is still with us today. The Library entrusts the very important task of selecting journals to be indexed to an advisory group of consultants that includes physicians, editors and librarians. Of the 20,000 health-related periodicals received by the Library, 2,300 are chosen for indexing (including *THE WESTERN JOURNAL OF MEDICINE*). Even with this high degree of selectivity, the number of journal article citations added each year to MEDLARS approaches a quarter million, and the total is now well over two million.

MEDLARS made possible not only the rapid production of bibliographies but also allowed for searching the data base in response to an inquiry from a health professional. Such individualized searches, however, were slow and required coding by a trained search analyst before being fed into the computer.

Spurred by increasing demands for search services and a growing backlog of requests, NLM undertook in the late 1960's to develop a more rapid and widely accessible system. The result, after several years of experimentation, was the implementation of MEDLINE (MEDLARS On-Line), a new service begun in October 1971.

Using MEDLINE, it is possible for health professionals throughout the United States (and in several foreign countries) to have immediate access to a data base of about half a million citations to the most recent articles. These articles are from more than 3,000 different biomedical journals, including those indexed for *Index Medicus*. Access is through computer terminals that are linked to the National Library of Medicine's IBM 370/158 computers by telephone and other communication lines (Figure 2). More than 300 hospitals, medical schools and medical research institutions in the United States have access to MEDLINE, and more than 400,000 computer searches are made each year.

MEDLINE is an interactive system, that is, the user identifies the journal article references he needs by carrying on a dialog with the computer—typing in successive queries on the terminal keyboard. MEDLINE recognizes some 13,000 medical subject headings, from ABATTOIRS to ZYMOSAN, that may be combined to search on

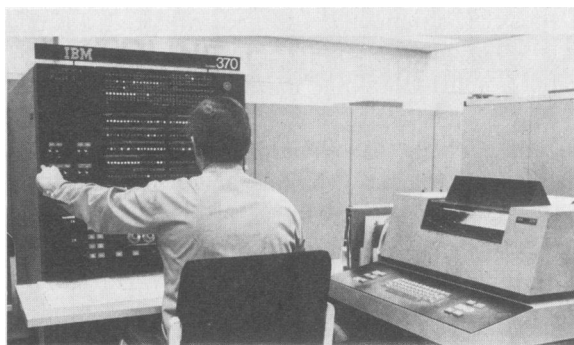


Figure 2.—Two IBM 370/158 computers are used to prepare the bibliographies and catalogs published by the Library and also provide rapid access to journal article references via MEDLINE.

a specific subject. Users may also search by an author's name, a word in the title or abstract of an article, a publication date, language, a specific journal title or a combination of these elements.

After pertinent references are located, the user prints out at the terminal the author, title, and journal source for each citation. It is also possible in some cases to print out an English abstract of the article. If a large number of references are retrieved (more than 25), they may be printed overnight at the National Library of Medicine and mailed to the requester the next day. The entire on-line search usually takes less than 15 minutes, and the charge is \$8.50 or less. Some MEDLINE Centers absorb the costs and make no charge to the user.

MEDLINE services are coordinated by eleven Regional Medical Libraries, each responsible for a geographic area of the country. The Pacific Northwest Regional Health Sciences Library, located at the University of Washington in Seattle, covers the states of Alaska, Idaho, Montana, Oregon and Washington. There are nine institutions offering MEDLINE services in this region. The Pacific Southwest Regional Medical Library Service is centered at the University of California, Los Angeles, Center for the Health Sciences. There are 58 MEDLINE centers in this four-state region (covering Arizona, California, Hawaii and Nevada).

From Citation to "Hard Copy"

To identify the needed literature is just the first step. The long-term trend of an increasing number of journals combined with the recent phenomenon of decreasing library budgets for acquisition make it unlikely that a health professional will be able to locate in a single library all the journal

articles identified in a thorough MEDLINE search. Outside of the National Library of Medicine, no other medical library in the United States subscribes to all 3,000 journals in MEDLINE.

To ensure that American physicians have access to this literature, the Library participates in a nationwide interlibrary loan network. If unable to provide a patron with a book or journal from its own collection, a local medical library will send a request for a photocopy to another library in the same region, or to the particular Regional Medical Library. The National Library of Medicine backs up the entire system and attempts to supply photocopies of material unavailable elsewhere.

In order to fill this role as a "library's library," NLM collects a wide range of materials in some 40 biomedical areas and, to a lesser degree, in such related subjects as general chemistry, physics, zoology, botany, psychology, instrumentation and other areas that are peripheral to (but sometimes indispensable in the study of) biomedicine. The holdings include some 1½ million books, journals, technical reports, theses, pamphlets, microfilms, and pictorial and audiovisual materials. More than 70 languages are represented in the collection.

Also housed at NLM is one of the world's finest collections of historical materials relating to medicine, dating from the 11th to the mid-19th century. A room with special temperature and humidity controls preserves the most valuable manuscripts and incunabula (books printed before 1500).

New Programs

In the last decade, the Library's mission has been expanded to include programs of grant support, research and development in the application of modern communications technology, toxicology information and audiovisual collection and development.

The United States Congress, responding to a series of reports and witnesses warning that the nation's medical libraries were in a serious state of disrepair, enacted the Medical Library Assistance Act in 1965. The Act, renewed with changes several times since then, provided for grant assistance for library construction, training in medical library science, carrying out research in library science and communications, improving library resources, establishing Regional Medical Libraries, and supporting publications. To date, almost

\$75 million has been distributed by NLM to medical libraries ranging in size from small hospital collections to major medical school libraries.

The second of the new mandates, the application of new technology, is the function of the Lister Hill National Center for Biomedical Communications. Established within the NLM in 1968, the Center is named after one of the cosponsors of the 1956 legislation that transferred the Library from the military to the Department of Health, Education, and Welfare. The Lister Hill Center has pioneered in the application of space-age technology for experimental networks, such as radio and television communication via satellite linking remote Alaska villages with a Public Health Service physician, and a two-way microwave television network in New England tying outlying local health facilities with Dartmouth College.

The third new activity at the Library, the Toxicology Information Program, is responsible for building computer-based data banks of information from the literature of pharmacology/toxicology, environmental pollution, occupational safety and health, and related disciplines. A major accomplishment of this program is the development of the on-line system TOXLINE—Toxicology Information On-Line. Similar in some respects to MEDLINE, the TOXLINE data base makes available to its more than 150 subscribers some 350,000 citations and abstracts to the literature of toxicology.

The National Medical Audiovisual Center, located in Atlanta, Georgia, is another component of NLM with a function not traditionally associated with a library. Audiovisuals are being used with increasing frequency at all levels of health-science instruction—for undergraduate and graduate training, and for continuing education of practitioners.

One of the problems faced by medical educators is that of identifying and acquiring audiovisual teaching materials appropriate for their students. To help meet this need, the National Medical Audiovisual Center has developed a computerized data base known as AVLINE (for Audiovisuals On-Line), accessed by the same terminals as MEDLINE. AVLINE citations contain not only an abstract, but information on where and how the audiovisual material may be obtained, the intended audience, and whether it has been rated "recommended" or "highly recommended"

by professional organizations evaluating the material.

Just as NLM provides photocopies of journal articles on interlibrary loan, the National Medical Audiovisual Center lends motion pictures and videotapes to institutions and to individual health professionals. In the past year the Center has filled about 60,000 requests for audiovisual material.

NLM is probably best known in the medical world for the printed bibliographic tools that provide access to this collection—chief among them, of course, being *Index Medicus*.

In addition to *Index Medicus*, however, there are a number of publications of more immediate interest to physicians. *Abridged Index Medicus* for example, is much less expensive and handier for office reference. Each monthly issue lists references to articles appearing in 100 English-language journals selected for their usefulness to the practitioner and for their coverage of all major fields of clinical medicine. Periodical lists of references in a number of medical specialties are prepared by the Library and published by cooperating professional societies and other government agencies. Such disparate fields as cerebrovascular disease, rheumatology, artificial kidney, anesthesiology, neurosurgery, dermatology and hypertension, to name just a few of the subjects, have specialized bibliographies devoted to them.

Despite the Library's involvement with telecommunications, satellites, audiovisuals and computer networks, great emphasis is placed on continuing the proud tradition started in the last century—the acquiring, organizing and maintaining of the world's greatest collection of published health-related literature. The information generated by modern biomedical research, however, has placed an enormous responsibility on the National Library of Medicine to devise improved methods of knowledge transfer. John Shaw Billings would no doubt take the Library's new programs and techniques in stride—viewing them as no more than natural extensions of what he had begun.

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